NEUT Meeting Report

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SciBooNE Collaboration Meeting - 2006-09-14

NEUT Meeting

• We had a short meeting on Aug 31 at FNAL to discuss how to use the NEUT neutrino interaction generator for SciBooNE simulations

• While maybe not highest priority in SciBooNE right now, important to start discussing this simulation aspect, as it will soon become crucial for SciBooNE physics analyses

• Meeting sounded like a good idea because of presence of Hayato-san (NEUT main developer and maintainer) at FNAL that day!

• Participants: Hayato, Hiraide, Kurimoto, Nakajima, Sorel, Tanaka, Yokoyama

Flux Input to NEUT

- Flux predictions from existing beam MC simulation of the Booster neutrino beamline

- Flux predictions for both antineutrino and neutrino running modes

- Start with simple files in ASCII format of accumulated fluxes, as a function of:
  - neutrino flavor: nue, nuebar, numu, numubar
  - neutrino parent: muon, pion, charged kaon, neutral kaon
  - neutrino energy: energy bins for 0<Enu<5 GeV range
  - radial position with respect to beam axis: radial bins for 0<r<225 cm range
  - three flux files (SciBar, EC, MRD), evaluated at subdetector average z positions
  - no flux binning as a function of neutrino direction, which will be assumed to be along z direction by NEUT

- Flux files to be provided by Michel on the timescale of ~1 month

Flux Input to NEUT (2)

• This simple proposal takes into account radial variations in overall flux and its energy shape, and of (first-order only) flux variations due to different subdetector distances from prod. target (few % effect)

• Unclear if/how neutrino parent information will be used, but costs little to add. Might be useful, for example, to tune flux predictions from neutrino data information from SciBooNE and MiniBooNE

• Better flux predictions, taking into account neutrino directional spread and flux variations within extended z dimensions of subdetectors, could be needed later on

• Morgan: up to 3 deg directional spread within SB fiducial volume!

• Possible implementation for better flux predictions: storing one flux entry per neutrino as opposed to accumulated quantities, in ntuples to be read by NEUT. NEUT input interface of this type is currently being considered for T2K as well, so synergies possible

Nuclear Targets in NEUT

- Nuclear effects on low-energy neutrino interactions are important -> try to approximate actual target material in NEUT simulation

- Given comparable masses and expected large fraction of backward-going tracks, useful to generate neutrino interactions not only in SciBar, but also in EC and MRD

- Possible assumptions for NEUT nuclear effects simulation:
  - 100% CH for SciBar
  - 100% Fe for EC (is this approximation good enough? Hayato-san: hard to simulate Pb nuclear effects...)
  - 100% Fe for MRD

- Hayato-san currently tuning NEUT nuclear effects on Carbon (timescale: 1-2 months)

- Global SciBooNE NEUT interactions simulation possibly by merging subdetector simulation results with proper tonnage weighting? Some book-keeping, but appears doable. Better ideas welcome!

NEUT Events in Detector MC

- Interface with NEUT generator already written by Hiraide-san
- Detector MC updates to come in future SciBooNE meetings
- Usual NEUT information should be propagated through MC output:
  - neutrino interaction vertex
  - true neutrino energy and interaction Q^2
  - number of particles in final state
  - type of final state particles
  - 3-momentum of final state particles

NEUT Access Within SciBooNE

- NEUT source code should be accessible to SciBooNE collaborators

- Issue with future NEUT code development by SciBooNE collaborators: keep in sync NEUT at SciBooNE with NEUT at Super-K, to avoid confusion! To the extent that Hayato-san is likely to be the main developer for both, realistically this might not be a problem

- A special NEUT CVS repository in Japan, accessible to SciBooNE collaborators, will be set up by Hayato-san and Yokoyama-san

- Longer term: NEUT code might become public

NUANCE

• SciBooNE rich neutrino cross-section physics program can take advantage of multiple neutrino interaction generators!

• NUANCE is another widely used generator in the neutrino community

• Sam Zeller is the lead NUANCE developer and maintainer in MiniBooNE, and she'd be happy to help with NUANCE also for SciBooNE

• We will start to have informal discussions (on the same style as the NEUT one) concerning NUANCE at SciBooNE soon